

Claims

What is claimed is:

1. A process for forming a silicon carbide structure, comprising:
molding by compression a mixture of a silicon precursor powder and a cross-linking thermoset resin to form a rigid structure;
carbonizing the rigid structure; and
forming a silicon carbide structure by heating the carbonized rigid structure at a temperature sufficient to allow carbon and silicon in the structure to react to form silicon carbide.
2. The process of claim 1, wherein a mean particle size of the silicon precursor powder ranges from about 1 to 100 μm .
3. The process of claim 1, wherein a mean particle size of the silicon precursor powder ranges from about 5 to 50 μm .
4. The process of claim 1, wherein the mixture comprises about 10 to 60% by weight of the silicon precursor powder.
5. The process of claim 1, wherein the mixture comprises about 10 to 60% by weight of the cross-linking thermoset resin.
6. The process of claim 1, wherein the mixture exhibits a carbon to silicon atomic ratio of about 1:1.
7. The process of claim 1, wherein the cross-linking thermoset resin has a carbon yield of at least 20% by weight.
8. The process of claim 7, wherein the cross-linking thermoset resin is a phenolic resin.
9. The process of claim 1, further comprising adding a silicon-containing filler in powder form to the mixture prior to molding the mixture.
10. The process of claim 9, wherein the silicon-containing filler comprises one selected from the group consisting of silicon carbide, silicon nitride, and silicate materials.

11. The process of claim 9, wherein the mixture comprises 10 to 75% by weight of the silicon-containing filler.
12. The process of claim 9, wherein a mean particle size of the silicon-containing filler is in a range from 1 to 100 μm .
13. The process of claim 1, further comprising adding a pore-forming filler to the mixture prior to molding the mixture.
14. The process of claim 13, wherein the pore-forming filler is added in an amount ranging from about 1 to 15% by weight.
15. The process of claim 1, further comprising adding an organic fibrous filler to the mixture prior to molding the mixture.
16. The process of claim 15, wherein the organic fibrous filler is added in an amount ranging from about 1 to 15%.
17. The process of claim 1, wherein carbonizing the rigid structure comprises heating the rigid structure in an inert atmosphere to a temperature in a range from 700 to 1000°C.
18. The process of claim 1, wherein forming the silicon carbide structure comprises heating the carbonized rigid structure in an inert atmosphere to a temperature in a range from about 1400 to 1800°C.
19. A process for forming a silicon carbide structure, comprising:
compression-molding a mixture of a silicon precursor powder, a cross-linking thermoset resin, and a silicon carbide powder to form a rigid structure;
carbonizing the rigid structure; and
forming a silicon carbide structure by heating the carbonized rigid structure at a temperature sufficient to allow carbon and silicon in the structure to react to form silicon carbide.
20. The process of claim 19, wherein a mean particle size of the silicon precursor powder and the silicon carbide powder ranges from about 1 to 100 μm .

21. The process of claim 19, wherein the mixture exhibits a carbon to silicon atomic ratio of about 1:1.
22. The process of claim 19, wherein the cross-linking thermoset resin has a carbon yield of at least 20% by weight.
23. The process of claim 22, wherein the cross-linking thermoset resin is a phenolic resin.
24. The process of claim 19, wherein the cross-linking thermoset resin is water-soluble.
25. The process of claim 19, wherein the mixture comprises 10 to 75% by weight of the silicon carbide powder.
26. The process of claim 19, wherein the mixture comprises 10 to 60% by weight of the silicon precursor powder.
27. The process of claim 19, wherein the mixture comprises about 10 to 60% by weight of the cross-linking thermoset resin.
28. The process of claim 19, further comprising adding an organic fibrous filler to the mixture in an amount ranging from 1 to 15% prior to compression-molding the mixture.
29. The process of claim 19, further comprising adding a pore-forming filler to the mixture in an amount ranging from 1 to 15% prior to compression-molding the mixture.
30. The process of claim 19, wherein carbonizing the rigid structure comprises heating the rigid structure in an atmosphere to a temperature in a range from 700 to 1000°C.
31. The process of claim 19, wherein forming the silicon carbide structure comprises heating the carbonized rigid structure in an inert atmosphere to a temperature in a range from about 1400 to 1800°C.
32. A process for forming a silicon carbide structure, comprising:
compression-molding a mixture of a silicon precursor powder and a cross-linking thermoset resin to form a rigid structure;

carbonizing the rigid structure in an inert atmosphere at a temperature in a range from about 700 to 1000°C to convert the cross-linking thermoset resin to carbon; heating the rigid structure in an inert atmosphere to a temperature in a range from about 1400 to 1800°C to allow the carbon to react with silicon in the rigid structure to form silicon carbide.

33. The process of claim 32, further comprising adding a silicon-containing filler in an amount ranging from 10 to 75% to the mixture prior to compression-molding of the mixture.
34. The process of claim 33, wherein the silicon-containing filler comprises one selected from the group consisting of silicon carbide, silicon nitride, and silicate materials.
35. The process of claim 32, further comprising adding a pore-forming filler to the mixture in an amount ranging from about 1 to 15% by weight prior to compression-molding of the mixture.
36. The process of claim 32, further comprising adding a fibrous filler to the mixture in an amount ranging from about 1 to 15% by weight prior to compression-molding of the mixture.